R E M A R K S

Reconsideration of this application, as amended, is respectfully requested.

THE CLAIMS

Independent claim 1 has been amended to clarify that the ejection voltage supply includes an electrode which contacts with the solution to charge the solution. In addition, independent claim 1 has been amended to clarify that the operation controller controls a voltage having a reversed polarity to the ejection voltage to be applied by the electrode to the solution inside the nozzle just before or just after the ejection voltage is applied to the solution inside the nozzle. See the disclosure in, for example, Fig. 1 and paragraph [0027] at pages 22-23 in the specification.

In addition, claims 11-20 have been added to recite additional features of the present invention based on the disclosure in, for example, Figs. 1 and 2, and the disclosure in paragraph [0009] at pages 5-6, paragraphs [0021]-[0022] at page 18, paragraphs [0024]-[0025] at page 19-21, and paragraph [0027] at pages 22-23.

No new matter has been added, and it is respectfully requested that the amendments to the claims be approved and entered.

THE PRIOR ART REJECTION

In the Final Office Action, claims 1, 3, 4, 7, 9 and 10 were again rejected under 35 USC 103 as being obvious in view of the combination of previously cited USP 5,477,249 ("Hotomi"), USP 6,017,112 ("Anderson et al") and USP 6,382,754 ("Morikoshi et al"). This rejection, however, is respectfully traversed with respect to the claims as amended hereinabove.

According to the present invention as recited in amended independent claim 1, a liquid ejection apparatus is provided which comprises a liquid ejection head having a nozzle with an inner diameter of at most 15 μm, and an ejection voltage supply to apply an ejection voltage to a solution inside the nozzle so as to charge the solution. As recited in amended independent claim 1, the ejection voltage supply includes an electrode which contacts with the solution to charge the solution.

In addition, the liquid ejection apparatus of amended independent claim 1 comprises a convex meniscus generator to cause the solution inside the nozzle to rise from the nozzle in a convex shape, and an operation controller to control application of a drive voltage to drive the convex meniscus generator and application of the ejection voltage by the ejection voltage supply so that the drive voltage to the convex meniscus generator is applied in timing overlapped with the application of a pulse voltage as the ejection voltage by the ejection voltage supply.

Still further, as recited in amended independent claim 1, the operation controller controls a voltage having a reversed polarity to the ejection voltage to be applied by the electrode to the solution inside the nozzle just before or just after the ejection voltage is applied to the solution inside the nozzle.

It is respectfully submitted that even if all of Hotomi, Anderson et al and Morikoshi et al were combinable in the manner suggested by the Examiner, they still would not disclose, teach or suggest the above described features of the ejection voltage supply and operation controller of the present invention as recited in amended independent claim 1.

On page 4 of the Final Office Action, the Examiner acknowledges that Hotomi fails to expressly teach that the "operation controller controls the application of a voltage having reversed polarity to the ejection voltage to be applied to the solution inside the nozzle just before or just after the ejection voltage is applied to the solution inside the nozzle." For this reason, the Examiner has cited Morikoshi et al.

It is respectfully submitted, however, that Morikoshi et al merely discloses driving voltage signals applied to a piezoelectric vibrator (not ejection voltage signals applied to a solution inside a nozzle) to effectively attenuate the kinetic energy of the meniscus and to hold the meniscus at a position

suitable for jetting out the next droplet to provide a stable print output.

By contrast, according to the claimed present invention, ejection voltage is applied to the solution inside the nozzle (by the electrode) to electrostatically charge the solution to let droplets of the charged solution fly in an electrostatic field. That is, the ejection voltage (or the voltage having reversed polarity, both of which applied are by the electrode) does not relate to a mechanical force given to the solution to move the meniscus of the solution. And it is respectfully submitted that the driving voltage applied to the actuator (9) of Morikoshi et al does not at all correspond to the voltage (having reversed polarity) for electrostatic charge as according to the claimed present invention.

In addition, it is respectfully submitted that it would not have been obvious to one of ordinary skill in the art to apply the voltage control of the piezoelectric vibrator (9) of Morikoshi et al to voltage regulation for electrostatic charge in Hotomi to arrive at the subject matter of the claimed present invention. Since Hotomi already teaches the piezoelectric vibrator (14), at best, the voltage control of the piezoelectric vibrator (9) of Morikoshi et al might be applied to the voltage control of the piezoelectric vibrator (14) of Hotomi, but not to the voltage regulation for electrostatic charge in Hotomi. And

it is therefore respectfully submitted that Morikoshi et al is not combinable with Hotomi in the manner suggested by the Examiner.

Still further, it is respectfully pointed out that the problems faced by the present invention are associated with application of electrostatic charge. That is, the problems of electro-wetting effect at a nozzle tip caused by the ejection voltage, suspended particles in the solution being concentrated toward the nozzle, and charge-up of the nozzle are associated with the application of the electrostatic charge. And with the structure of the present invention as recited in amended independent claim 1, an advantageous effect is produced whereby the above problems are overcome. See the disclosure in the specification at paragraph [0049] at pages 49-50.

Morikoshi et al, by contrast, is merely related to a piezoelectric vibrator which provides mechanical pressure to a solution to discharge droplets from a nozzle, and is not associated with the application of an electrostatic charge. Therefore, it is respectfully submitted that the above problems do not even occur in Morikoshi et al, and clearly therefore, Morikoshi does not disclose, teach or suggest the above described structural features of the present invention as recited in amended independent claim 1 which overcome the above problems.

Yet still further, it is respectfully submitted that Morikoshi et al does not disclose, teach or suggest a voltage of reversed polarity to the ejection voltage. That is, it is respectfully submitted that Morikoshi et al does not disclose, teach or suggest a driving voltage which fluctuates between positive and negative. On page 6 of the Final Office Action, the Examiner refers to Fig. 24(a) of Morikoshi et al and asserts that the amplitude of pulse S1 starts from zero (in Fig. 24(a)). However, it is respectfully pointed out that this is not correct. See column 17, line 48 to column 18, line 37 of Morikoshi et al, and in particular see column 18, lines 15-19 which discloses that:

> "When the second pulse control signal P2 is turned in succession in the course of recovery of the meniscus, time equivalent to the pulse width pw2 is required to discharge the piezo-electric vibrator 9 up to zero-voltage and the piezo-electric vibrator 9 starts extending." (emphasis added)

That is, in Fig. 24(a) of Morikoshi et al, the driving pulse becomes zero at the period pwh2 where the voltage is the lowest, and not at the initial state before first pulse S1. Therefore, the driving pulse always has a positive voltage and does not become negative. In other words, in Morikoshi et al, the driving pulse does not reverse its polarity. This is further evidenced by the disclosure in Figs. 17(f), 18(a) and 21(f) of Morikoshi et al where a zero-volt line is drawn below the signal.

Therefore, it is respectfully submitted that Morikoshi et al does not at all disclose, teach or suggest a voltage with reversed polarity as according to the claimed present invention. Moreover, with the structure of the claimed present invention, the advantageous effect of overcoming the above described problems is achieved because of the voltage with the reversed polarity which reduces or balances out electrostatic charge. And it is respectfully submitted that this advantageous effect cannot be obtained by the driving pulse of Morikoshi et al.

In summary, it is respectfully submitted that Morikoshi et al is not combinable with Hotomi in the manner suggested by the Examiner, and in addition it is respectfully submitted that even if all Morikoshi et al, Hotomi and Anderson et al were in fact combinable, they still would not disclose, teach or suggest the ejection voltage supply and the operation controller of the present invention as recited in amended independent claim 1.

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In view of the foregoing, it is respectfully submitted that the present invention as recited in amended independent claim 1 and claims 3, 4, 7, 9 and 10-20 depending therefrom clearly patentably distinguishes over Hotomi, Anderson et al and Morikoshi et al, taken singly or in combination, under 35 USC 103.

Entry of this Amendment, allowance of the claims and the passing of this application to issue are respectfully solicited.

If the Examiner has any comments, questions, objections or recommendations, the Examiner is invited to telephone the undersigned at the telephone number given below for prompt action.

Respectfully submitted,

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